

Table 1

## (1) Comparison of the Present Invention and the Cited Reference

|                                 | Present Invention             | NSC/Tamehiro  |   |
|---------------------------------|-------------------------------|---|---|
| Publication No.                 | 2004SN00625                   | WO96/23909  |   |
| Filing Date or Publication Date | Application filed 2003.1.14   | 1996.8.8  |   |
| What is claimed is              |                               |   |   |
| Compon<br>ent(mass%<br>)        | C                             | 0.03-0.1  | 0.05-0.10   |
|                                 | Si                            | 0.01-0.5  | $\leq 0.6$  |
|                                 | Mn                            | 1.2-2.5   | 1.7-2.5   |
|                                 | P                             |   | $\leq 0.015$  |
|                                 | S                             |   | $\leq 0.003$  |
|                                 | Al                            | $\leq 0.08$   | $\leq 0.06$   |
|                                 | Nb                            | 0.005-0.07  | 0.01-0.10   |
|                                 | V                             | 0.005-0.1   | 0.01-0.10   |
|                                 | Ti                            | 0.005-0.04  | 0.005-0.030   |
|                                 | Cu                            | $\leq 0.5$  | 0.1-1.2   |
|                                 | Ni                            | $\leq 0.5$  | 0.1-0.6   |
|                                 | Cr                            | $\leq 0.5$  | 0.1-1   |
|                                 | Mo                            | 0.05-0.4  | 0.15-0.60   |
|                                 | B                             | $\leq 0.005$  | 0.0003-0.0020   |
|                                 | Ca                            | 0.0005-0.003  | 0.001-0.006   |
|                                 | N                             |   | 0.001-0.006   |
|                                 | REM                           |   | 0.001-0.02  |
|                                 | Mg                            |   | 0.001-0.006   |
|                                 | C/(Mo+Ti+Nb+V)                | 1.2-3   |   |
|                                 | P value                       |   |   |
| Metal<br>structure              |                               | Ferrit-bainite-MA<br>MA fraction:3-20%<br>Complex carbon nitride of grain size<br>of less than 10nm is precipitated in<br>ferrite | Martensite-ferrite-bainite<br>Ferrite fraction:20-90%<br>Ratio of worked ferrite in ferrite: 50-100%                          |
|                                 |                               |   | $\Rightarrow$ different   |
| Process<br>of making            | Heating<br>temperature        | 1000-1300   | 950-1300  |
|                                 | Rolling finish<br>temperature | $\geq Ar3$  | 650-800   |
|                                 | Rolling reduction<br>rate     |   | 50% or more at 950°C or more<br>10-70% in two-phase region of Ar3-Ar1<br>points<br>Air cooling or accelerated cooling at 10°C |
|                                 | Cooling rate                  | $\geq 5^{\circ}\text{C/s}$  |   |
|                                 | Cooling stop                  | 450-650   | $\leq 500^{\circ}\text{C}$  |
|                                 | Heating rate                  | $\geq 0.5^{\circ}\text{C/s}$  |   |
|                                 | Reheating<br>temperature      | 550-750   |   |
| Mechani<br>cal                  | Pipe forming                  |   |   |
|                                 |                               | Low yield ratio   | Low yield ratio   |